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Rieffe, C.J.; Meerum Terwogt, M.; Koops, W.; Hagenaar, J.

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The Desirability of Beliefs: Preschoolers' Appreciation of Fact Beliefs and Subsequent Emotions

Carolien Rieffe*, Mark Meerum Terwogt, Willem Koops and Janneke Hagenaar
Free University, Amsterdam, The Netherlands

In this study, we investigated the extent to which preschool children's own knowledge about reality biases their understanding that others' beliefs about reality govern others' emotions and not reality itself. Therefore, an increasing tension was created between the beliefs of the protagonist and the participant, by providing varying degrees of evidence about the validity of the protagonist's belief. Children of between 4 and 5 years of age were asked to predict the protagonist's emotion, given the protagonist's desire and the protagonist's belief. The results show that, to a certain extent, preschool children take others' beliefs into account when predicting others' emotions. When the outcome is clear, children probably feel tied to reality, and in the case of false beliefs, their knowledge about reality biases their emotion predictions, as was also evident in 'false belief' research (Wimmer H, Perner I. 1983. Beliefs about beliefs: representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition* 13: 103–128). However, when it is uncertain what the actual outcome will be, then it is not the likelihood of others' beliefs but the desirability of the outcome that biases children's predictions of others' emotions. In other words, when the actual outcome is yet unclear, 4- and 5-year-olds show a tendency for wishful thinking in their predictions of others' emotions. Copyright © 2000 John Wiley & Sons, Ltd.

Key words: understanding beliefs; desirability; emotion prediction

All of us experience occasions when our perception has fooled us: 'I was sure that . . . !', but reality turned out to be different. This subjective perception of reality forms an essential part of the emotional experience of a situation. It is not the brute fact that one's bicycle is not where it was left that makes one annoyed after a nice evening in the pub, but the fact that one *thinks* that the bicycle has been stolen, even if, in fact, one does not remember the actual spot where the bicycle was left or if the bicycle has only been moved by someone to another

* Correspondence to: Department of Developmental Psychology, Free University, vd. Boechorststraat 1, 1081 BT Amsterdam, The Netherlands. E-mail: c.rieffe@psy.vu.nl

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spot near the pub. In other words, it is not the actual situation, but *beliefs* about the situation that dictate which emotion is elicited (Frijda, 1986). However, beliefs can be misleading and one becomes upset (as in the example of the bicycle) over nothing.

In order to understand another's emotion, an observer should be able to take into account the other's beliefs about the situation (Harris, 1989; Meerum Terwogt and Stegge, 1995; Rieffe, 1998). One has to understand that different people can have different beliefs, and that another's belief concerns a mental representation of reality, which can deviate from the factual situation. One has to understand that it is this mental (mis)representation of reality that determines how a person feels, and not reality itself. Harris *et al*. (1989) provided children aged 4–6 years with situations in which the protagonist held a so-called false belief; the protagonist falsely believed that a Smartie box would contain Smarties, whereas (as participants knew) the Smartie box actually contained stones. Participants were asked to predict how the protagonist would feel when [s]he was given the box but had not yet discovered its actual contents. Most emotion predictions by the 4-year-olds (75%) were based on their own belief and stated that the protagonist would be unhappy, as if the protagonist could know that the box did not contain Smarties. Half of the emotion predictions by the 5-year-olds and 75% of the emotion predictions by the 6-year-olds were based on the protagonist's false belief and stated that the protagonist would be happy receiving the box.

Despite these difficulties with evidently false beliefs, there is confirmation that when children lack the knowledge about the relationship between the protagonist's belief and reality, in other words, when they do not know whether the protagonist's belief is true or false, children are more likely to appreciate the protagonist's belief and accurately predict the protagonist (emotional) reaction. Support for this hypothesis stems from the *ownership task* of Flavell *et al*. (1992) and the *not-own belief task* of Wellman (1990). In Flavell *et al*.'s experiment, participants were told a story in which two children were fighting over a coat, but the owner of the coat was not identified. In contrast with the other belief tasks in which the true state of affairs was identified, 3-year-olds accurately reproduced the conflicting beliefs of both protagonists. Wellman asked participants whether they thought Sam's dog would be in the garage or in the kitchen. Then participants were told that the protagonist thought the opposite. Again, the true location of the dog was not identified. Even 3-year-olds predicted where Sam would look for the dog based on Sam's belief. When they were told in advance where Sam's dog actually was, in the garage or in the kitchen, the majority failed to predict Sam's action based on Sam's false belief.

It is appropriate to refer to Flavell *et al*.'s ownership task and Wellman's not-own beliefs task as tasks with beliefs of unknown truth value, because participants could not know whether the protagonist's beliefs were true or false. In Flavell *et al*.'s task, participants have no belief at all, or at least no expressed belief and in Wellman's task, they lack information about the validity of their own belief. An experiment by Harris *et al*. (1989) also used beliefs of unknown truth value, but in connection with the prediction of the protagonist's emotion. Participants were uninformed about the content of a box, which could contain milk or orange juice. Given the protagonist's preference, almost all 5-year-olds predicted the protagonist's emotion based on the protagonist's belief. Three-year-olds had some difficulties predicting this when the correct emotion prediction would be unhappy, i.e. when the protagonist thought [s]he would receive the non-preferred drink, but they performed well when the protagonist thought [s]he would receive the preferred item.

In conclusion, the results on these various tasks reveal a difference between preschool children's performance on tasks involving false beliefs versus beliefs of unknown truth value. There are different ways to explain these results. It is frequently argued that false belief tasks are the ultimate criterion for whether children appreciate the subjective character of beliefs. Consequently, children who do not accurately predict others' emotions based on others' false beliefs, fail to understand that people's beliefs govern their emotions and not reality. The fact that those children accurately predict others' emotions in the case of beliefs of unknown truth value can be alternatively explained: children apply a reality assessment, meaning that another's belief is perceived as a statement about reality and not as one particular perspective on reality (Perner, 1988). Clearly, it is easier to apply a reality assessment in cases where it is unknown what the relationship is between another's belief and reality, than in cases where one knows another's belief to be false. Another possibility is that children's performance on false belief tasks is no valid criterion for their understanding of beliefs. For example, preschool children might very well understand that other people's beliefs cause their emotional reactions, but a false belief might still be too extreme for these young children (see Harris, 1996; Mitchell, 1996 for an overview of this discussion).

As one can see, it is difficult to determine which performances indicate children's appreciation of the fact that others' emotions are caused by their beliefs about reality and not by reality itself. Nevertheless, it is possible to conclude from the results described so far that preschool children judge other people's beliefs in the light of their own knowledge about reality. It seems that children frequently attribute their own belief to others when they know that others' beliefs misrepresent reality. If reality is not known, others' beliefs are more easily accepted in their emotion predictions. Yet, children's bias by their own ideas about reality is probably not restricted to situations where children are sure about the outcome, but it will also occur in the case of beliefs of unknown truth value. This study alms to investigate when and how children's own view on reality biases their predictions of others' emotions, not only in the case of false beliefs, but with regard to beliefs of unknown truth value as well.

Note, however, that the influence of children's own beliefs on their predictions of others' emotions could operate in different ways. Considering children's different responses on the various tasks with beliefs of unknown truth value and false belief tasks, two hypotheses are possible. The first, which we will call *the categorical hypothesis*, states that children make a categorical distinction between beliefs whose truth value is known (i.e. whose relationship to reality is evident) and beliefs whose truth value is not known. Beliefs whose truth value is deemed true or false are not regarded as extreme cases on a continuous dimension that also includes beliefs of unknown truth value, but rather as separate categories. In other words, children effectively apply three different categories: a true or a false category when they feel sure about the actual state of affairs, as in the false belief task of Harris *et al*. (1989), and an unknown category to all other cases. The expectation is that children who find a false belief task difficult when they are sure about reality might nevertheless appreciate others' beliefs in the case of beliefs of unknown truth value. Yet, their own ideas about reality might have a stronger influence on their emotion predictions when the protagonists' beliefs are of unknown truth value than when the protagonists' beliefs are true.

The second, which we will call the *likelihood continuum hypothesis*, states that the influence of children's own perception on their emotion predictions has a gradual character. The validity of the protagonist's belief is influenced by its probability as perceived by participants. Thus, children's predictions of others' emotions are increasingly biased by their own belief to the extent that the others' beliefs are perceived as improbable and thus, unlikely. Consequently, they experience an increasing tension between their own belief and the protagonist's belief to the extent that the protagonist's belief is perceived as unlikely. The greater this tension, the more participants are tempted to neglect the protagonist's belief and predict the protagonist's emotion based on their own belief. On this account, all beliefs are perceived as lying on a continuum from virtually impossible to virtually certain.

EXPERIMENT: VIRTUALLY IMPOSSIBLE TO VIRTUALLY CERTAIN BELIEFS

An experiment was carried out to explore if, and to what extent, tension between children's beliefs and others' beliefs influences children's predictions of others' emotions and to distinguish among the two formulated hypotheses. In this experiment, an increasing tension was created between the beliefs of the protagonist and the participant, by providing varying degrees of evidence about the validity of the protagonist's belief. Two types of items were offered in different proportions, 5 apples and 5 oranges; 0 apples and 10 oranges; 2 apples and 8 oranges. Participants were asked to predict the protagonist's emotion, given the protagonist's desire and the protagonist's belief. The categorical hypothesis predicts that in making emotion predictions, children will be more accurate for true beliefs than for beliefs of unknown truth value; and more accurate for beliefs of unknown truth value than for false beliefs. The likelihood continuum hypothesis predicts that emotion predictions will be more accurate when the tension between the participant's belief and the other's belief is reduced. Thus, this hypothesis predicts that children will be more accurate for beliefs of unknown truth value if they are deemed likely rather than unlikely. On this hypothesis, contrary to the categorical hypothesis, children would differentiate among beliefs of unknown truth value that differ in their likelihood. This design assumes that children grasp the concept of probability, and this was checked in a preliminary study.

METHOD

Participants

A sample of 30 4-year-olds (mean age 4-6 (4 years, 6 months); range 4-0 to 4-11) and 37 5-year-olds (mean age 5-6; range 5-1 to 6-0) was drawn from primary schools in the suburbs around Amsterdam, The Netherlands, and tested by one examiner. An additional 27 4-year-olds (mean age 4-7; range 4-0 to 4-11) and 28 5-year-olds (mean age 5-5; range 5-0 to 6-0) participated in the preliminary study and came from a primary school located in the centre of The Netherlands. This experiment was carried out by a teacher of this school. In both samples, approximately half of the participants were male and half were female.

Preliminary study

Studies in the Piagetian tradition define probability in terms of long-run frequencies of events (Piaget and Inhelder, 1975). In this experiment, however, we assume children's understanding of probability or chance as expectancy per unique event (see Anderson, 1991 for a discussion of the Piagetian frequentist view versus the personal probability view). In other words, we conceptualized probability as degree of belief. There is evidence that preschool children have an understanding of probability. For example, Schneider *et al.* (1989) showed that even 3-year-olds could make realistic estimates of their chance of success or failure. In another study, 4- and 5-year-olds showed an understanding of how graded expectancy depends on the ratio of winners and losers (Anderson and Schlottmann, 1991). In the research by Anderson and Schlottmann, children were asked to explicitly state their degree of belief: they were asked how easy it was to pick a winning (baby blue) or a loosing (black) marble from a cup.

Our design is slightly different to that of Anderson and Schlottmann in that we required children to apply their understanding of probability. In our study, 4- and 5-year-old children were asked to wager a given number of matches after they had made a guess. In order to familiarize participants with the principle of making a wager, the teacher who carried out this experiment sat down with the class in a circle and introduced a game of marbles. She drew one marble from a jar and put it in a mug in a way that no one could see the marble's colour. One child was asked by the teacher to guess what colour of marble was in the mug. The child was given four matches and asked how many matches [s]he wanted to put next to the mug. This wager only concerned the colour of marble that the child had guessed. The child was told that if [s]he felt sure about the colour [s]he had guessed, [s]he should put many matches next to the mug, but if [s]he was not so sure, [s]he should not put so many matches next to the mug. If [s]he had guessed the wrong colour of marble, the experimenter would take the matches and keep them. However, if [s]he had guessed the right colour of marble, the number of matches would be doubled by the experimenter and returned to the child. The experimenter used various alternative ways to describe each procedural step, until she felt certain that all children knew what was expected from them. The procedure was repeated with different children in the circle, until several children had won and several children had lost the game.

Following this procedure, children were taken individually from the group to a separate, quiet place by the same experimenter. Participants faced six empty mugs. Beside each mug were four matches and a little bag with ten marbles. Each bag contained blue and/or red marbles, with ten marbles in total. Figure 1 shows the six proportions of red and blue marbles (labels x-as), which were presented randomly. Red and blue were counter-balanced across participants. One bag was opened and the marbles were taken out. The experimenter asked participants to count the red and blue marbles. Note that 4- and 5-year-olds understand one-to-one mapping with counts and they can draw cardinal conclusions (Freeman *et al.*, 2000). All ten marbles were then returned to the little bag. The experimenter closed her eyes, shook the bag, drew one marble from the bag and put it in the mug, without participants being able to see which colour she took out. Participants were encouraged to guess the colour of marble in the mug. Then the experimenter responded with: 'So you think there is a red [blue] marble in the bag. How many matches do you want to put next to the mug? How sure are you?' After participants had put at least one match and up

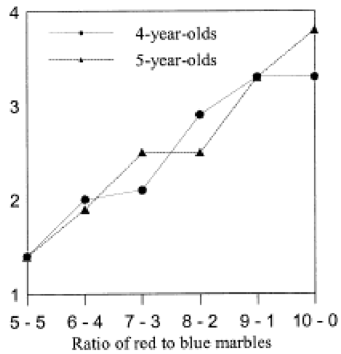

Figure 1. Mean number of staked matches as a junction of Age $\times$ Ratio of red to blue marbles.

to a maximum of four matches next to the mug, the experimenter went on to the next mug, until all mugs contained a marble and participants had put matches next to every mug. Then, the content of each mug was opened and participants were given or deprived of the appropriate number of matches.

Figure 1 also shows the mean number of staked matches as a function of age and ratio. Participants could stake a minimum of one match and a maximum of four matches per condition. Inspection of Figure 1 shows that the number of staked matches increased linearly as the probability of a correct guess increased. Furthermore, it can be seen that 5-year-olds staked more matches when they were more certain about the outcome (10–0 condition) than the 4-year-olds did. A 2(Age) $\times$ 6(Ratio) analysis of variance (ANOVA) with repeated measures on the last factor confirmed a main effect for Ratio ($F(5, 265) = 58.68$, $p = 0.000$) and an interaction of Age $\times$ Ratio ($F(5, 265) = 2.82$, $p = 0.017$), but no main effect for Age ($F(1, 53) = 0.13$; $p = 0.718$). Analysis by ANOVA in which the six conditions were tested for their rank-order confirmed this linear trend for Ratio for each age group ($p = 0.000$). Although both 4- and 5-year-olds adjusted their wager to the likelihood of a correct guess, it seems that 4-year-olds did not fully understand the concept of probability, because they did not stake the maximum number of matches in the condition where they would have surely won: the 10–0 condition.

There might be several explanations for this phenomenon. First, even after the group session in which the teacher had tried to familiarize the children in every possible way with the concept of 'being sure' of something, it is still possible that the youngest did not fully understand the question 'How sure are you?' or its consequences (staking everything if you are completely sure). References to mental processes can easily create confusion at this age (e.g. Mitchell and Robinson, 1992). However, the fact that even the youngest children responded correctly to differences in probability makes this explanation seem unlikely. Alternatively, we might argue that 4-year-olds' reactions to the extreme conditions indicate that they are less willing than 5-year-olds to rely on their own logical reasoning: 'I did not see a red marble in the bag, but the experimenter may be a magician and make one'. A third possibility is that children might have reacted to a perceptual cue (7 out of 10 marbles are red, so the child stakes 3 out of 4 matches) and thus produced correct answers without a probability understanding. This possibility has been extensively discussed and refuted by Anderson (1991). Although we might conclude on the basis of this experiment that 4-year-olds' understanding of probability is not yet perfect, it has been shown to be sufficient for the next experiment.

Procedure

Before testing the participants individually, the experimenter had a group conversation with each class from which participants were drawn. In this conversation she first introduced the dolls to be used later on in the experiment: Bear family and Rabbit family (both families consisting of five members: father, mother, brother, sister and baby), so that participants would not be surprised or distracted by the dolls during the actual testing. Second, five fixed pairs of candies (one liked, one disliked) were introduced and children were trained to memorize the desired and the undesired member of each pair. These fixed pairs were applied to the stories that were presented afterwards. The experimenter told the group that:

> the animals will have a party in the woods and at this party, every animal receives one candy. Just one. But they won't get it just like that. I will go with one child at a time to another room and the child and I will play a game with the animals. With each animal one by one. And then we will see which candy they will get. The candy they like, or . . . the candy they don't like.

A group discussion ensued about why eating more than one candy was not right. Many children reasoned, for example, that more candies would be bad for the animals' teeth or health. The children were told that, in the upcoming game, there would always be a fixed pair of candies: one candy liked by bears and rabbits, one candy disliked by bears and rabbits. Each candy was represented by a drawing on a card. The experimenter showed the cards one by one to the group and named them so that the children could memorize the appropriate name for each candy. The cards were shown again, but now in five fixed pairs, of which only one candy was liked by the animals and this preference per pair was trained with the group.

Then children were taken individually from their group to a separate room and tested in two sessions of approximately 15 min per session. Participants were presented with ten stones, five stones per session (Table 1). In half of the stories, participants were told that the animal thought [s]he would receive the desired candy. The correct emotion prediction was happy for these stories. In the other half, they were told that the animal thought [s]he would receive the undesired candy. The correct emotion prediction was unhappy. The five stories per session were randomly selected from the total of ten, but in such a way that two [three] stories had a happy emotion prediction, and three [two] an unhappy emotion prediction. Half of the participants were presented with the Bear family

Table 1. Beliefs with different degrees of likelihood

Combination of candies	Desire bear	Belief bear, happy response	Belief bear, unhappy response
10 red–0 yellow	Red candy	Red (true)	Yellow (false)
8 red–2 yellow	Red candy	Red (unknown)	Yellow (unknown)
5 red–5 yellow	Red candy	Red (unknown)	Yellow (unknown)
2 red–8 yellow	Red candy	Red (unknown)	Yellow (unknown)
0 red–10 yellow	Red candy	Red (false)	Yellow (true)

in the first session and the Rabbit family in the second. This was reversed for the other half of the participants.

A pair of candies was presented to the child by showing the appropriate cards and participants were asked to recall the protagonist's desire: 'Bears are very fond of . . . But bears really dislike . . . That is right'. If participants failed this memory check, the experimenter again trained the desired and undesired items per pair. The experimenter had five little bags in front of her, one for each member of Bear family [Rabbit]. She took one bag and opened it: 'Let us see how many candies are in this bag'. Every bag contained ten candies with different ratios for the two types of candies in a fixed pair (Table 1). For example, the bag contained eight wine-gums and two mints; five wine-gums and five mints; or 0 wine-gums and ten mints. The experimenter said: 'Let's count the candies. How many mints do I have? That is right. And how many wine-gums? So, there are many [a few] [no] wine-gums here and a few [many] mints'. The experimenter put all candies back in the little bag, shook the bag, took one candy out with her eyes closed and put the candy in a mug without participants being able to see which kind of candy she had taken out.

Father-bear had been out of sight up till this point in the experiment. Thus, father-bear was also unaware of the ratio of one kind of candy to another. Father-bear was now put on the table in front of the mug: 'Well, it's father-bear's turn to play the game with us'. Half of the participants were asked the question: 'Father-bear thinks that there is a mint in the mug. How does he feel? Does he feel happy or unhappy?' (1). The other half was asked 'Father-bear thinks that there is a wine-gum in the mug. How does he feel? Does he feel happy or unhappy?' (1). All participants were then asked 'And what do you think is in the mug?' (2) and 'What did father-bear want? A mint or a wine-gum?' (3). Then the experimenter continued with the next member of the Bear family. The order of presented family-members was randomized over participants. A different pair of candies was used for each new bear. Participants were presented with five different ratios of desired versus undesired candies. The first column in Table 1 shows that the ten candies could consist of 0, 2, 5, 8 or 10 candies desired by the protagonist. The remaining candies were the undesired candies. The order of story-type (ratio of desired to undesired candies) was randomized over participants. When all five story-types per session had been presented, participants were asked to open each mug and see which candy was there. After opening the mug the experimenter asked: 'So, how does [s]he feel now?' (4). Finally, children were asked which candy of a pair they liked most (5).

Results

All children performed well on the memory question for the protagonist's desire (question (3): 4- and 5-year-olds, respectively, 93% and 97% correct), irrespective of story-type. Figure 2 shows the mean number of correct emotion predictions. These results are collapsed over age because there was no difference in results between the 4-year-old and the 5-year-old participants: overall, 5-year-olds performed better on the emotion prediction questions than 4-year-olds (85% versus 64% correct); however, the responses of the two age-groups showed the same pattern. It can be seen that participants performed better on stories with a happy than an unhappy emotion prediction, except for the condition in which the protagonist holds a false belief.

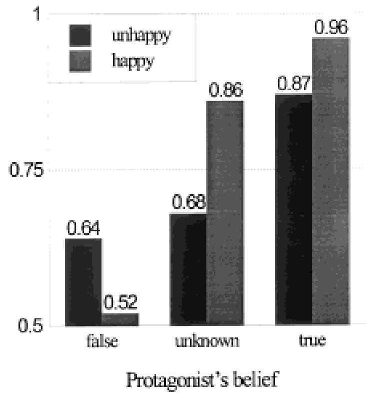

Figure 2. Proportion correct emotion predictions as a junction of Beliefs (false, unknown, true) $\times$ Valence.

The categorical hypothesis does not predict a systematic difference between the three conditions with beliefs of unknown truth value. When analysed separately, a 2(Age) $\times$ 3(RPB: 2, 5 or 8) $\times$ 2(Valence) ANOVA with repeated measures on the last two factors confirmed that the three conditions with beliefs of unknown truth value did not differ from each other ($F(2, 130) = 1.65$, $p = 0.195$). Figure 2 shows the results based on the categorical hypothesis in which the three conditions with beliefs of unknown truth value are represented by their mean. It can be seen that the proportion of correct emotion predictions between the three belief conditions diverge as one would expect on the basis of the categorical hypothesis: false < unknown < true. A 2(Age) $\times$ 3(Belief: false, unknown or true) $\times$ 2(Valence: happy versus unhappy emotion prediction) ANOVA with repeated measures on the last two factors confirmed a main effect for Age ($F(1, 65) = 23.88$, $p = 0.000$), Belief ($F(2, 130) = 39.37$, $p = 0.000$) and an interaction of Belief $\times$ Valence ($F(2, 130) = 7.24$, $p = 0.001$).

It can also be seen in Figure 2 that the responses for stories with a happy as compared with an unhappy emotion prediction differ more strongly in the case of beliefs of unknown truth value than in the other two conditions. *Post hoc* analyses confirmed a difference between stories with a happy and an unhappy emotion prediction in the case of unknown beliefs ($T = 2.80$, df = 66, $p = 0.007$), but not for false belief stories ($T = 1.43$, df = 66, $p = 0.159$) or true belief stories ($T = 1.76$, df = 66, $p = 0.083$). Thus, the valence of the emotion prediction influenced children's responses in the case of beliefs whose truth value was unknown, and only to a lesser extent in the case of beliefs whose truth value was judged true or false.

Figure 3 shows children's responses to the separate story-types. It can be seen that correct responses increased when the probability of the protagonist's belief being true increased. Nevertheless, this increase clearly shows no linear trend as was predicted by the likelihood continuum hypothesis. A cubic trend appears instead ($p < 0.000$), which shows that the increase in correct responses goes up from false beliefs to the uncertain cases, where it flattens out and then goes up again for true beliefs. A 2(Age) $\times$ 5(RPP (ratio protagonist's belief): 0, 2, 5, 8 or 10) $\times$ 2(Valence: happy versus unhappy emotion prediction) ANOVA with repeated measures on the last two factors confirmed a main effect for Age ($F(1, 65) = 32.38$, $p = 0.000$), RPB ($F(4, 260) = 18.86$, $p = 0.000$) and an interaction of RPB $\times$ Valence ($F(4, 260) = 4.99$, $p = 0.001$).

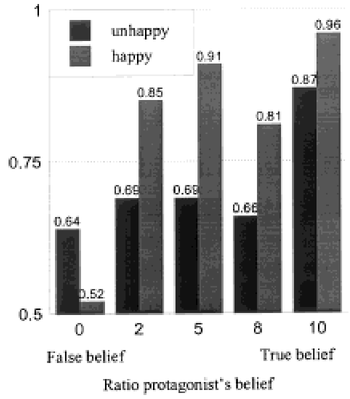

Figure 3. Proportion correct emotion predictions as a junction of Belief × Valence.

After they had given an emotion prediction, children were asked for *their* belief: 'And what do you think is in the mug? (question (2)). If children applied their understanding of chance, they should expect the protagonist to receive the majority item, especially in the conditions where only ten candies of one kind were presented. The conditions with certain outcomes (10 or 0 desired candies) indeed showed this pattern. In the case of uncertain outcomes, however, children more often guessed that the protagonist would receive the *desired* candy of a pair, irrespective of the objective probability of the candy to be picked. Figure 4 presents the percentage of children expecting the protagonist to receive the desired candy as a function of the objective probability of that candy to be picked (0, 0.2, 0.5, 0.8 or 1). The scores are collapsed over age because there was no difference in results between 4- and 5-year-old participants.

It can be seen that, in the case of uncertain outcomes, children more often predicted that the majority item would be in the mug when the majority item consisted of desired candies. When the minority item consisted of desired candies children more often thought that the protagonist would receive the minority item. When there were only two desired candies presented, only 26%

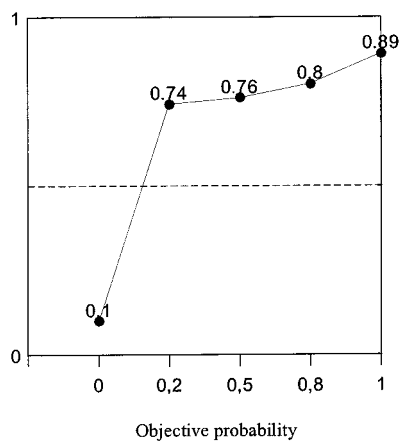

Figure 4. Percentage of children expecting the protagonist to receive the desired candy.

of the children thought that the protagonist would receive the majority item, which consisted of the undesired candy. Based on this unexpected pattern, we included children's expectations with respect to the *desired* candy in the analysis. The 5–5 conditions contained no majority item, and therefore, were not included in the analysis. A $2 \times$ (Age) $\times$ 2(Certainty: certain versus uncertain outcomes) $\times$ 2(Desire expectations: expectation for desired versus undesired candy) ANOVA with repeated measures on the last two factors confirmed a main effect for Desire expectation ($F(1, 65) = 65.09$, $p = 0.000$) and an interaction of Desire expectation $\times$ Certainty ($F(1, 65) = 23.35$, $p = 0.000$).

In conclusion, children expected the animals to receive the desired candy in story-types where different outcomes were possible, irrespective of the chance of that outcome. This result is consistent with participants' expectations in the 5–5 conditions, because 76% of the participants thought that the protagonist would receive the desired candy in both 5–5 conditions. Children showed this tendency to a much lesser extent in story-types where only one outcome was possible.

Children were also asked which candy of each pair they preferred (question (5)). Their responses were highly consistent with the bear's and rabbit's preferences, because the protagonists' preferences and the animals' preferences were consistent in 74% of cases.

Finally, when all family-members had had their turn and all mugs contained a candy, participants opened each mug and were asked 'How does [name protagonist] feel now?' (question (4)). Other findings have shown that preschoolers can accurately predict the protagonist's emotion based on the protagonist's desire and the situation (Wellman and Bartsch, 1988). Thus, not surprisingly, both age groups performed very well on this task, although 5-year-olds (97% correct) performed better than 4-year-olds (87% correct). Scores on stories with a happy or an unhappy emotion prediction did not differ. A $2 \times$ (Age) $\times$ 2(Valence) ANOVA with repeated measures on Valence confirmed a main effect for Age ($F(1, 65) = 6.61$, $p = 0.012$).

DISCUSSION

Children who correctly predict another's emotion based on the other's misconception of reality, clearly acknowledge that emotions are evoked by someone's perception of reality and not by reality itself. Recent evidence demonstrates that 6-year-olds have this understanding, whereas many younger children ignore the protagonist's false belief in their emotion predictions and attribute their own belief (Harris *et al*., 1989). When the relationship between the protagonist's belief and reality is unknown, younger children are also more likely to accurately predict another's emotion (Harris *et al*., 1989; Wellman, 1990; Flavell *et al*., 1992). This indicates that children's knowledge—or, in fact, their own beliefs—about the validity of the protagonist's beliefs influences the way they predict the protagonist's emotions.

Based on our results, which show the following hierarchy of accurate emotions predictions: false beliefs > beliefs of unknown truth value > true beliefs, one might conclude that children operate along a continuum, where false and true beliefs are opposite end anchors. However, the results of this experiment conflict with the likelihood continuum hypothesis. The absence of a linear effect suggests that the preschool children in this research were not biased in their predictions of the protagonist's emotion by an increasing likelihood of the protagonist's belief. It seems as if preschool children apply different mechanisms when it comes to predicting others' emotions in the case of certain outcomes as compared with uncertain outcomes. Collapsed over Valence, the pattern of responses fits the predictions of the categorical hypothesis: children were more accurate for true beliefs than for beliefs of unknown truth value; and more accurate for beliefs of unknown truth value than for false beliefs.

However, an unexpected factor added to this difference in children's responses: wishful thinking. Although correct responses increased with age, both 4- and 5-year-olds were more accurate in making a happy than an unhappy emotion prediction in the case of beliefs whose truth value was unknown (see also Harris *et al.*, 1989). One could argue that children probably think that receiving the undesired candy is a happy outcome in any case, but only story-types in which the actual outcome was uncertain were biased this way.

In other words, when the outcome is evident, so that another's belief is perceived as either patently true or patently false, children's emotion predictions are frequently biased by the attribution of their own beliefs based on their knowledge about reality. When the outcome is uncertain, so that the other's belief is a belief of unknown truth value, children's responses show a remarkable pattern: it is not their *knowledge* about the probability of the protagonist's belief being true, but the *desirability* of the outcome that appears to bias their predictions of others' emotions. It appears that children frequently attribute the most desirable belief to the protagonist. As a result, they tend to predict more happy emotions than unhappy emotions. Clearly, this *happy bias* can be more easily affected when the outcome is still uncertain than when there is only one possible outcome and the protagonist's belief is either true or false. Children might feel less hindered by their knowledge about reality when the outcome is still uncertain. They might have the optimistic presumption that others' desires will be fulfilled anyhow. For example, they might assume that the adult experimenter will find a way to give the protagonist the desired candy, because both kind of candies, the desired and the undesired, are in the mug.

Children's own beliefs about the actual outcome confirm this explanation. Preschoolers had shown a good understanding of chance when they were asked to make a wager (note that their desire here was to win the game). Nevertheless, the same aged children did not base their own beliefs about the actual outcome on probability, but on the desirability of a candy. Especially in the case of uncertain outcomes, children mostly thought that the protagonist would receive the desired candy instead of the candy with the greatest chance to be picked. Remarkably, children seemed to have identified themselves with the animals to the extent that their preferences for candies had become identical to those of the animals. Thus, their optimistic beliefs about the actual outcome matched both the protagonists' and their own desires.

The lack of concern with whether a belief of unknown truth value has a smaller or a larger probability of being true, but instead, the expectation—if there is any probability at all—for the most positive outcome, is probably not only present in children, but can be existent among adults as well. One only has to recall the last world football championship, and many of us will remember how convinced they were that their national team would win the world cup. The issue of how the desires of older children and adults might influence their understanding of others' emotions will be addressed in future research.

Overall, preschool children make different judgements about situations in which they are, or are not, certain about the relationship between the protagonist's belief and reality when this information appears to be relevant for the prediction of the protagonist's emotion. Perner (1991, p. 173) states that hypothetical situations are marked with respect to their *likelihood* or *likeability*. Our results show that children are affected by the *likelihood* (probability) of another's belief when they are sure about the outcome. However, in the case of beliefs of unknown truth value, the *likeability* (desirability) of the outcome biases their responses. Thus, when they are not hindered by hard and fast knowledge about reality, preschool children show a tendency for wishful thinking in their predictions of others' emotions. These results confirm a Dutch saying which states that 'the desire is the father (the cause) of the belief'.

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REFERENCES

Anderson NH. 1991. Probability development. In *Information Integration Theory*. *Volume III*. *Developmental*, Anderson NH (ed.). Lawrence Erlbaum Associate: Hillsdale, NJ; 83–108.

Anderson NH, Schlottmann A. 1991. Developmental study of personal probability. In *Information Integration Theory*, *Volume III*. *Developmental*, Anderson NH (ed.). Lawrence Erlbaum Associates: Hillsdale, NJ; 111–134.

Flavell JH, Mumme DL, Green FL, Flavell ER. 1992. Young children's understanding of different types of beliefs. *Child Development* **63**: 960–977.

Freeman NH, Antonucci C, Lewis C. 2000. Representation of the cardinality principle: early conception in of error in a counterfactual test. *Cognition* **74**: 71–89.

Frijda N. 1986. *The Emotions*. Cambridge University Press: Cambridge.

Harris PL. 1989. *Children and Emotion*. Blackwell: Oxford.

Harris PL. 1996. Desires, beliefs, and language. In *Theories of Theories of Mind*, Carruthers P, Smith PK (eds). Cambridge University Press: Cambridge; 200–222.

Harris PL, Johnson CN, Hutton D, Andrews G, Cooke T. 1989. Young children's theory of mind and emotion. *Cognition and Emotion* **3**: 379–400.

Meerum Terwogt M, Stegge H. 1995. Children's understanding of the strategic control of negative emotions. In *Everyday Conceptions of Emotion: An Introduction to the Psychology*, *Anthropology and Linguistics of Emotion*, Russell JA, Fernandez-Dols J, Manstead ASR, Wellenkamp JC (eds). Kluwer Academic Publishers: Dordrecht; 373–390.

Mitchell P. 1996. *Acquiring a Conception of Mind—A Review of Psychological Research and Theory*. Psychology Press: Hove.

Mitchell P, Robinson EJ. 1992. Children's understanding of the evidential connotation of 'know' in relation to overestimation of their own knowledge. *Journal Child Language* **19**: 167–182.

Piaget J, Inhelder B. 1975. *The Origin of the Idea of Chance in Children*. Norton: New York.

Perner J. 1988. Developing semantics for theories of mind: from propositional attitudes to mental representations. In *Developing Theories of Mind*, Astington J, Harris P, Olson D (eds). Cambridge University Press: New York; 141–172.

Perner J. 1991. *Understanding the Representational Mind*. MIT Press: Cambridge, MA.

Rieffe C. 1998. The child's theory of mind: understanding desires, beliefs and emotions. Dissertation, Free University, Amsterdam, The Netherlands.

Schneider K, Hanne K, Lehmann B. 1989. The development of children's achievement-related expectancies and subjective uncertainty. *Journal of Experimental Child Psychology* **47**: 160–174.

Wellman HM. 1990. *The Childs Theory of Mind*. MIT Press: Cambridge, MA.

Wellman HM, Bartsch K. 1988. Young children's reasoning about beliefs. *Cognition* **30**: 239–277.

